

AS Computer Science Test: Unit 11 Programming techniques 12 Algorithms

18th Nov 2024

Name: _____ Group: _____ Mark: /60 Grade: _____

Answer all questions

1. Read the pseudocode below and complete the trace table with the following data:

20, 25, 4, 1, 10

```

temperature = 0
highest = 0
lowest = 50
total = 0
for index = 1 to 5
    temperature = input ("Enter temperature: ")
    if temperature > highest then
        highest = temperature
    endif
    if temperature < lowest then
        lowest = temperature
    endif
    total = total + temperature
next index
average = total/5
print ("Highest", highest)
print ("Lowest", lowest)
print ("Average", average)
    
```

Complete the trace table with the following data 20, 25, 4, 1, 10

| temperature | highest | lowest | total | average | index | Output |
|-------------|---------|--------|-------|---------|-------|--------|
| 0 | 0 | 50 | 0 | | | |
| | | | | | 1 | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

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2. Write pseudocode for a program which outputs the total of all the even numbers within a range entered by the user. [5]

3. Describe briefly three(3) advantages of using subroutines in programs [6]

4. Write a pseudocode algorithm using a **for ... next** loop to read five lowercase letters and output the largest and smallest. (a is less than b). [5]

5

A 2-dimensional (2D) array, data, holds numeric data that Karl has entered. The declaration for the array is:

```
array data[16,11]
```

The array data, has 16 'rows' and 11 'columns'.

Fig. 1.1 shows an extract from data.

| | 0 | 1 | 2 | 3 | ... | 10 |
|-----|-----|-----|-----|-----|-----|-----|
| 0 | 1 | 5 | 7 | 12 | ... | 36 |
| 1 | 3 | 4 | 15 | 16 | ... | 48 |
| 2 | 0 | 0 | 1 | 3 | ... | 10 |
| 3 | 12 | 16 | 18 | 23 | ... | 100 |
| ... | ... | ... | ... | ... | ... | ... |
| 15 | 6 | 10 | 15 | 25 | ... | 96 |

Fig. 1.1

The data in each 'row' is in ascending numerical order.

Karl needs to analyse the data.

(a) Karl needs to find out if a number he enters appears in a given row of the array. He is going to use a search algorithm to do this.

(i) State the name of two different search algorithms that Karl could consider using.

1

2

[2]

- (ii) Choose one search algorithm from those you gave in part (i), and describe how this algorithm works.

Algorithm _____

Description _____

[5]

- (b) Karl needs to output the median value of each 'row' of the array.

The median is found by having all the numbers in a row in ascending numerical order, and taking the middle value.

For example, in Fig. 1.2 below, the median element in the row is the third element, so the median value is 7.

| | | | | |
|---|---|---|----|----|
| 1 | 5 | 7 | 12 | 15 |
|---|---|---|----|----|

Fig. 1.2

Write an algorithm to output the median value of each 'row' of the 2D array data.

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- (c) Karl needs to find the mean average of each 'column' of the array. The mean is calculated by adding together the numbers in the column, and dividing by the quantity of numbers in the column.

For example, in Fig. 1.3 the first 'column' mean would be: $(1+3+0+12)/4 = 4$

| | | | |
|----|----|----|----|
| 1 | 5 | 7 | 12 |
| 3 | 4 | 15 | 16 |
| 0 | 0 | 1 | 3 |
| 12 | 16 | 18 | 23 |

Fig. 1.3

Write an algorithm to output the mean value of each 'column' in the array data.

[illegible]

- 6 (a) Explain how a serial search can be used to find the word **mongoose** in the list
baboon, cheetah, elephant, giraffe, leopard, lion, mongoose, rhinoceros [2]

- (b) Explain **one** disadvantage of a serial search compared with a binary search of any large sorted list of data. [2]

- (c) The binary search algorithm below processes an array called nameList. The names in nameList are stored in ascending alphabetical order and low, high, guess are all integer variables. animal contains the string being searched for in nameList. The operator div performs integer division.

```

found = False
high = len(nameList)-1
low = 0
while found == False and high >= low
    guess = (low + high) div 2
    if nameList[guess] == animal then
        found = True
    else
        if nameList[guess] > animal then
            high = guess - 1
        else
            low = guess + 1
        endif
    endif
endwhile
if found == True
    print ("animal found in position ", guess)
else
    print ("animal not in list")
endif

```

- (i) Complete the following trace table when animal = "lion" using the array:

nameList = ["baboon", "cheetah", "elephant", "giraffe", "hippo", "leopard",
"lion", "mongoose", "rhino", "warthog"]

[4]

| low | high | guess | nNameList(guess) | found |
|-----|------|-------|------------------|-------|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

- (ii) What is the maximum number of guesses that will be needed?

[1]

- (iii) What will be output if the user searches for "eland"?

[1]

- (iv) How many guesses would be needed to find an item in a list of 2000 items?

[2]

7

- a) The following incomplete pseudocode algorithm uses a binary search to find the integer numberToFind in the array array. It returns the index of the array or -1 if the integer is not found.

Complete the pseudocode algorithm.

```
function binarySearch(array, lowerbound, upperbound, numberToFind)
    lowerbound = 0
    upperbound = array.length - 1

    while true
        if (upperbound < lowerbound) then
            return -1
        else
            mid = (upperbound + lowerbound) / 2
            if (array[mid] < numberToFind) then
                lowerbound = mid + 1
            elseif (array[mid] > numberToFind) then
                upperbound = mid - 1
            else
                return mid
            endif
        endif
    endwhile
endfunction
```

[6]

- (b) An array stores the following data:

| | | | |
|----|---|----|----|
| 20 | 8 | 33 | 16 |
|----|---|----|----|

- (i) Describe how the given data will be sorted into **descending numerical order** using an insertion sort.

You should refer to the data in this array throughout your answer.

[Faint handwriting on lined paper]

[5]

END OF PAPER

Total 60 marks

